

## TABLE OF CONTENTS

CHAPTER	TITLE	PAGE
	<b>DECLARATION</b>	ii
	<b>DEDICATION</b>	iii
	<b>ACKNOWLEDGEMENTS</b>	iv
	<b>ABSTRACT</b>	v
	<b>ABSTRAK</b>	vi
	<b>TABLE OF CONTENTS</b>	vii
	<b>LIST OF TABLES</b>	xii
	<b>LIST OF FIGURES</b>	xiv
	<b>LIST OF SYMBOLS</b>	xvi
	<b>LIST OF APPENDICES</b>	xvii
 <b>1</b>	 <b>INTRODUCTION</b>	 <b>1</b>
	1.1 Background of the project	1
	1.2 Statement of problem	2
	1.3 Scope of the project	3
	1.4 Objectives of the study	3
	1.5 Research Outline	3
	1.6 Project Work Plan	4

<b>2</b>	<b>ULTRA WIDE-BAND TECHNOLOGY</b>	<b>5</b>
2.1	Introduction	5
2.2	Ultra Wide-Band Technology	6
2.2.1	Ultra Wide Band definition	6
2.2.2	Regulation World-wide	8
2.3	Ultra Wide-Band Applications	9
2.3.1	Communication Systems	10
2.3.2	Radar Systems	11
2.3.3	Positioning System	11
2.4	UWB Advantages and Disadvantages	12
2.5.1	Direct Sequence –Code Division Multiple Access (DS-CDMA)	13
2.5.2	Orthogonal Frequency Division Modulation (OFDM)	13
2.6	Summary	15
 <b>3</b>	 <b>ULTRA WIDE-BAND ANTENNA CHARACTERISTICS</b>	 <b>16</b>
3.1	Historical view of UWB Antenna	16
3.2	Antenna Parameters	19
3.2.1	Antenna Gain	20
3.2.2	Radiation Pattern	20
3.2.3	Polarization	22
3.2.4	Directivity and Efficiency	23

3.2.5	Return Loss	24
3.2.6	Bandwidth	24
3.3	Antenna types	25
3.3.1	Wire Antenna	26
3.3.2	Aperture antenna	26
3.3.3	Microstrip Antenna	27
3.3.4	Reflector Antenna	28
3.3.5	Array antenna	29
3.4	Feeding Techniques	29
3.5	UWB Antennas	32
3.5.1	UWB Antenna for Biomedical Imaging	32
3.5.1.1	Biomedical dipole, monopole and loaded dipole antenna	32
3.5.1.2	Bowtie UWB Antenna	33
3.5.1.3	Spiral UWB antenna	34
3.5.2	UWB Antenna for Communication Systems	34
3.5.2.1	Co-Planar Waveguide (CPW) disk monopole Antennas	34
3.5.2.2	Microstrip Line Fed Disk Monopole Antennas	35
3.6	Summary	37

<b>4</b>	<b>DESIGN METHODOLOGY</b>	<b>38</b>
4.1	Introduction	38
4.2	Antenna design Requirements	38
4.3	Parameter Study	39
4.3.1	Propose multiple antenna designs	39
4.3.2	Substrate effect	39
4.4	Design of the project	40
4.5	Project Procedures	41
4.6	Summary	43
 <b>5</b>	 <b>FORK AND CIRCULAR SLOTTED ULTRA WIDE-BAND ANTENNA DESIGN</b>	 <b>44</b>
5.1	Introduction	44
5.2	Fork Shape Ultra Wide Band (UWB) Antenna	44
5.2.1	Rectangular Microstrip Antenna	45
5.2.2	Cutting the patch	47
5.2.3	Slotted and stepped antenna	47
5.2.4	Partial Grounded substrate	47
5.3	Slotted circular antenna	49
5.3.1	Slotted circular patch	49
5.4	Fabrication and measurement procedures	51
5.4.1	Print out the designs by using transparency (photo film)	51

5.4.2	Ultraviolet exposure process	51
5.4.3	Etching in developer solution	51
5.4.4	Soldering the proposed antennas	51
5.4.5	Test the designs	52
5.5	Summary	53
<b>6</b>	<b>RESULTS AND CONCLUSION</b>	<b>54</b>
6.1	Introduction	54
6.2	UWB Fork shape antenna results	54
6.2.1	Simulated and measured return loss result	54
6.2.2	Simulated gain and radiation pattern	55
6.2.3	Measurement Radiation Pattern	58
6.2.4	3D Radiation Pattern Simulation	59
6.3	UWB Slotted circular patch antenna	60
6.3.1	Measured and simulated return loss	60
6.3.2	Simulated gain and radiation pattern	61
6.3.3	Measurement Radiation Pattern	64
6.3.4	3D Radiation pattern Simulation	66
6.4	Fork shape and slotted circular UWB antenna comparison	67

<b>7</b>	<b>CONCLUSION AND FUTURE WORKS</b>	<b>69</b>
	7.1 Conclusion	69
	7.2 Future Work	70
	<b>REFERENCES</b>	<b>71</b>
	Appendix A	73

**LIST OF TABLES**

<b>TABLE NO.</b>	<b>TITLE</b>	<b>PAGE</b>
1.1	Planning schedule of the project	4
2.1	Limitation of Indoor and handheld UWB devices	7
2.2	Ultra wide Friendly Zone (UFZ) limits in Singapore	9
3.1	Return Loss relationship with power transmitted and reflected	24
5.1	Basic Fork patch Antenna geometric	48
5.2	Circular patch geometric	50

## LIST OF FIGURES

<b>FIGURE NO.</b>	<b>TITLE</b>	<b>PAGE</b>
2.1	Using Ultra Wide-Band in body-centric Application	5
2.2	UWB Characteristics according to FCC	7
2.3	UWB regulations as Electronic Communications Committee (ECC)	8
2.4	Wireless Networks Range and Standards	10
2.5	Multi Carrier Frequency division multiplexing	13
3.1	Carter's Proposed Antenna.	17
3.2	Planar Log-periodic Antenna	18
3.3	Isotropic Pattern	20
3.4	3D Radiation Pattern	21
3.5	2D Radiation Pattern	21
3.6	Linear Polarization	22
3.7	Circular Polarization	22
3.8	5.6GHz to 5.9GHz antenna bandwidth	25
3.9	Dipole Antenna current and voltage connected to feeder	26
3.10	Microstrip Antenna	27
3.11	Different shapes of patch antenna	28
3.12	Parabolic Antenna	28



3.13	Varies antenna types	29
3.14	Rectangular MSA fed by (a) microstrip line, (b) Electromagnetic coupling, (c) Aperture coupling, And (d) coplanar waveguide (CPW)	31
3.15	Loaded dipole antenna	33
3.16	Bowtie antenna	33
3.17	CPW slotted antenna	35
3.18	Microstrip line dipole antenna	36
5.1	Rectangular patch Antenna	46
5.2	Fork shape antenna dimension	48
5.3	Circular patch Antenna	50
6.1	Measured and simulated return loss for UWB fork shape patch antenna	55
6.2	Simulated radiation pattern of UWB fork shape patch antenna: (a) E-plane at 6GHz, (b) H-plane at 6GHz, (c) E-plane at 8GHz and (d) H-plane at 8GHz	57
6.3	Radiation Pattern measurement at 6 GHz	58
6.4	3-D radiation pattern of UWB fork shape Antenna at 6GHz	60
6.5	Measured and simulated return loss for UWB Slotted circular patch antenna	61
6.6	Simulated radiation pattern of UWB slotted circular patch antenna: (a) E-plane at 6GHz, (b) H-plane at 6GHz, (c) E-plane at 8GHz and (d) H-plane at 8GHz	63
6.7	Measruemnt result of slotted circular path antenna at 6 GHz.(a) E-plane, (b) H-Plane	65
6.8	3-D radiation pattern of UWB slotted circular patch antenna at 6GHz.	66

## LIST OF SYMBOLS

2D	-	Two dimension
3D	-	Three dimension
$E_{eff}$	-	Effective dielectric constant
$E_0$	-	Dielectric constant of free space
$\lambda$	-	wavelength
$C$	-	velocity of light
$D$	-	directivity
dB	-	decible
$f$	-	Frequency
$P_i$	-	Incident Power
$R$	-	Resistance
RL	-	Return Loss
$V$	-	Voltage
TEM	-	Transverse Electromagnetic
$Z_0$	-	Characteristics impedance

**LIST OF APPINDICES**

<b>APPENDICES</b>	<b>TITLE</b>	<b>PAGE</b>
<b>A</b>	PUBLISHMENT OF “Propose a Slotted Fork Ultra-Wide Band (UWB) Antenna” IN SCOReD CONFERENCE	73